ENA EREC G98/1-4:2019

Requirements for the connection of Fully Type Tested Micro-generators
(up to and including 16 A per phase)
in parallel with public Low Voltage Distribution Networks on or after 27 April 2019

Report reference No. ..... :	P2020071502	
Tested by (printed name and signature) ..... :	Daniel Keis	.....
Approved by (printed name and signature) ..... :	Manuel Shimasaki	.....
Date of issue ..... :	3 August 2020	
Testing Laboratory Name ..... :	EnTEST Laboratories	
	Tests indicated as traceable only are outside of the laboratory's scope of accreditation	
Address ..... :	1 Treffers Road, Wigram, Christchurch 8042, New Zealand	
Testing location/procedure ..... :	NZ ☒	
Other (please explain) ..... :		
Applicant's Name ..... :	Enphase Energy	
Address ..... :	47281 Bayside Pkwy, Fremont, CA 94538, USA.	
Test specification		
Standard ..... :	ENA EREC G98/1-4:2019	
Test procedure ..... :	EnTEST Laboratories	
Non-standard test method ..... :		
Test Report Form No. ..... :	ENA EREC G98/1-4:2019	
TRF originator. ..... :	EnTEST Laboratories	
Non-standard test method ..... :		

Test item description ..... :	Solar Micro-inverter
Trademark ..... :	ENPHASE.
Manufacturer ..... :	Enphase Energy Inc.
Model and/or type reference ..... :	IQ7A-72-X-Y-Z
Rating(s) ..... :	See rating table

Model rating table:

Specification	Units	IQ7A
Maximum continuous output power	VA	349
Peak output power	VA	366
Nominal output voltage	V_{rms}	230
Output voltage range	V_{rms}	176-276
Nominal output frequency	Hz	50
Output frequency range	Hz	45-55
AC output current	A_{rms}	1.52
EN50530 efficiency	%	96.5
Full power MPPT input voltage range	V	38-43
Input operating range	V	18–58
Input frequency	Hz	DC
Input maximum continuous current	A	10.2
DC LSC input maximum	A	15
Ingress protection		IP67
Environmental category		Outdoor
Wet locations		suitable
Pollution degree		PD3
Ambient temperature		-40C to +60C
Relative humidity		4K4H
Maximum altitude		< 2000m
Overvoltage category		OVC III

Models IQ7A-72-X-Y-Z are similar except as indicated above.
Model nomenclature details:
X = 2, 5, E or blank
- 2 = Multicontact PV connector adapter
- 5 = Amphenol PV connector adapter
- E = EN4 PV connector

Y = blank or ACM = AC Module
Z = blank or any letter for country of intended installation e.g.:
- INT = International
- FR = France
- NL = Netherlands
- DE = Germany
- UK = United Kingdom

Firmware version:
520-00082-r01-v04.18.02

Copy of marking plate

Model: **IQ7A-72-X-Y-Z**

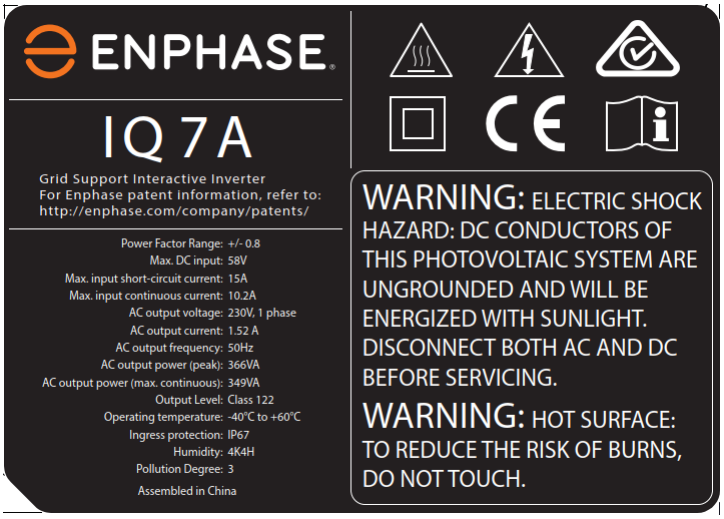

Figure 1: IQ7A marking plate

SUMMARY OF COMPLIANCE WITH ENA EREC G98/1-4:2019

All tests passed the requirements of the ENA EREC G98/1-4:2019 standard within the required limits and within the equipment uncertainties.

The system, consisting of Photovoltaic Micro-inverters model number IQ7A-72-X-Y-Z **COMPLIED** with the tested clauses of ENA EREC G98/1-4:2019.

Possible test case verdicts:

- test case does not apply to the test object ..... : N/A
- test object does meet the requirement ..... : P(Pass)
- test object does not meet the requirement ..... : F(Fail)
- informative information only ..... : Noted

Testing .....:

Date of receipt of test item.....: 13 April 2020

Date (s) of completion of tests.....: 22 July 2020

General remarks:

1. The test results presented in this report relate only to the object tested.
2. This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.
3. If the measured result complies up to the limit of acceptance, the result shall be reported along with our uncertainty of measurement. e.g. results to state window of uncertainty.
4. "(see Enclosure #)" refers to additional information appended to the report.
5. "(see appended table)" refers to a table appended to the report.

General product information:

The EUT (Equipment Under Test), known as Photovoltaic Micro-inverters, model number IQ7A was supplied for testing to ENA EREC G98/1-4:2019 by Enphase Energy Inc of 47281 Bayside Pkwy, Fremont, CA 94538, USA.

Worst case uncertainty of Measurements

Parameter	Range	Instrument accuracy of Measuring Range
Voltage		
- Up to 1000 V	up to 1 kHz	±1,5 %
	1kHz up to 5 kHz	±2 %
	5 kHz up to 20 kHz	±3 %
	20 kHz and above	±5 %
- 1000 V and above	dc up to 20 kHz	±3 %
	20 kHz and above	±5 %
Current		
- Up to 5 A	up to 60 Hz	±1,5 %
	above 60 Hz up to 5 kHz	±2,5 %
	5 kHz up to 20 kHz	±3,5 %
	20 kHz and above	±5 %
- Above 5 A	up to 5 kHz	±2,5 %
	5 kHz up to 20 kHz	±3,5 %
	20 kHz and above	± %
Leakage (Touch) current[1]	50 Hz up to 60 Hz	±3,5 %
	greater 60 Hz up to 5 kHz	±5 %
	greater 5 kHz up to 100 kHz	±10 %
	greater 100 kHz up to 1 MHz	under consideration
Power (50/60 Hz)	up to 3 kW	±3 %
	above 3 kW	±5 %
Power Factor (50/60 Hz)		±0,05
Frequency	up to 10 kHz	±0,2 %
Resistance	1 mW up to 100 mΩ and above 1 MΩ up to 1 TΩ	±5 %
	above 1 TΩ	±10 %
	for all other cases	±3 %
Temperature[2,3]		
	- 35°C to below 100° C	±2° C
	100° C up to 500° C	±3° C
	below - 35°C	±3° C
Time	10 ms up to 200 ms	±5 %
	200 ms up to 1 s	±10 ms
	1 s and above	±1 %
Linear dimensions	up to 1 mm	±0,05 mm
	1 mm up to 25 mm	±0,1 mm
	25 mm and above	±0,5 %
Mass	above 10 g and up to 100 g	±1 %
	100 g up to 5 kg	±2 %
	5 kg and above	±5 %
Force	for all values	±6 %
Mechanical energy	for all values ± 10%	±10 %
Torque		±10%
Angles		±1 degree
Relative humidity	30% to 95% RH	±6% RH
Barometric air pressure		±10 kPa

1. The stated tolerances apply to the total tolerance of the leakage (touch) current circuit and metering Instrument.
2. Thermocouple not included in the Instrument accuracy of measuring range. Thermocouples type “T” premium grade, are recommended.
3. Not for measurements related to relative humidity.

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Form C: Type Test Verification Report

All Micro-generators connected to the **DNO Distribution Network** shall be **Fully Type Tested.** This form is the **Manufacturer's** declaration of compliance with the requirements of G98.
This form should be used when making a Type Test submission to the Energy Networks Association (ENA).
If the **Micro-generator** is **Fully Type Tested** and already registered with the ENA **Type Test Verification Report** Register, the **Installation Document** should include the **Manufacturer**'s Reference Number (the Product ID), and this form does not need to be submitted.
Where the **Micro-generator** is **Fully Type Tested and** not registered with the ENA **Type Test Verification Report** Register this form needs to be completed and provided to the **DNO**, to confirm that the **Micro-generator** has been tested to satisfy the requirements of this EREC G98.

Manufacturer's reference number	IQ7A-72-X-Y-Z
Micro-generator technology	Micro-Inverter
Manufacturer name	Enphase Energy Inc
Address	47281 Bayside Pkwy, Fremont, CA 94538, USA.

Tel		Fax	
E-mail		Web site	Enphase.com

Registered Capacity, use separate sheet if more than one connection option.	Connection Option	
	0.349 kW	kW single phase, single, split or three phase system
		kW three phase
		kW two phases in three phase system
		kW two phases split phase system

Manufacturer Type Test declaration. - I certify that all products supplied by the company with the above **Type Tested** reference number will be manufactured and tested to ensure that they perform as stated in this document, prior to shipment to site and that no site modifications are required to ensure that the product meets all the requirements of EREC G98.

Signed		On behalf of	Enphase Energy

Note that testing can be done by the **Manufacturer** of an individual component or by an external test house.

Where parts of the testing are carried out by persons or organisations other than the **Manufacturer** then that person or organisation shall keep copies of all test records and results supplied to them to verify that the testing has been carried out by people with sufficient technical competency to carry out the tests.

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Operating Range: This test should be carried out as specified in EN 50438 D.3.1.

Active Power shall be recorded every second. The tests will verify that the **Micro-generator** can operate within the required ranges for the specified period of time.

The **Interface Protection** shall be disabled during the tests.

In case of a PV **Micro-generator** the PV primary source may be replaced by a **DC** source.

In case of a full converter **Micro-generator** (eg wind) the primary source and the prime mover **Inverter**/rectifier may be replaced by a **DC** source.

In case of a DFIG **Micro-generator** the mechanical drive system may be replaced by a test bench motor.

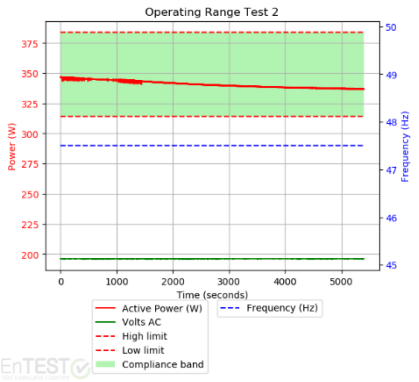
Test 1

Voltage = 85% of nominal (195.5 V)

Frequency = 47.5 Hz

Power factor = 1

Period of test 90 minutes



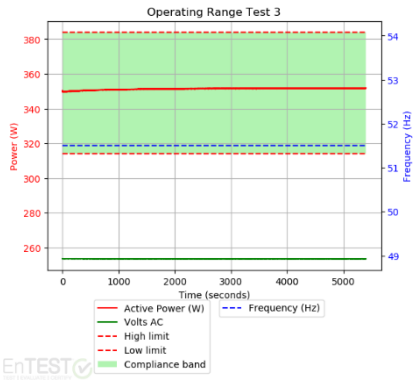
Test 2

Voltage = 110% of nominal (253 V).

Frequency = 51.5 Hz

Power factor = 1

Period of test 90 minutes



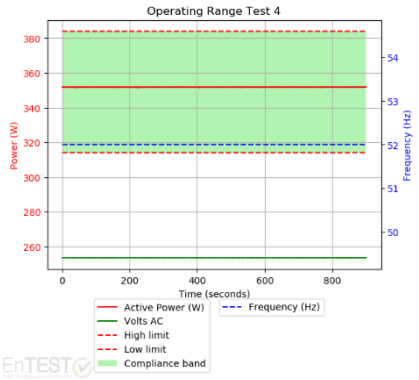
Test 3

Voltage = 110% of nominal (253 V).

Frequency = 52.0 Hz

Power factor = 1

Period of test 15 minutes



ilac-MRA ACCREDITED IANC TESTING LABORATORY Nº 1273

Tests indicated as traceable only are outside of the laboratory's scope of accreditation

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Power Quality – Harmonics: These tests should be carried out as specified in BS EN 61000-3-2. The chosen test should be undertaken with a fixed source of energy at two power levels a) between 45 and 55% and b) at 100% of **Registered Capacity**. The test requirements are specified in Annex A1 A.1.3.1 (**Inverter** connected) or Annex A2 A.2.3.1 (Synchronous).

Micro-generator tested to BS EN 61000-3-2

Micro-generator rating per phase (rpp)				2.21 kW		
Harmonic	At 45-55% of **Registered Capacity**		100% of **Registered Capacity**			
	Measured Value in Amps	Normalised	Measured Value in Amps	Normalised	Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2	0.0011	0.0018	0.0012	0.0020	1.080	
3	0.0387	0.0644	0.023	0.0383	2.300	
4	0.0008	0.0013	0.0009	0.0015	0.430	
5	0.0237	0.0395	0.021	0.0350	1.140	
6	0.0005	0.0008	0.0006	0.0010	0.300	
7	0.0167	0.0278	0.019	0.0316	0.770	
8	0.0005	0.0008	0.0006	0.0010	0.230	
9	0.008	0.0133	0.0128	0.0213	0.400	
10	0.0004	0.0007	0.0005	0.0008	0.184	
11	0.0044	0.0073	0.0115	0.0191	0.330	
12	0.0006	0.0010	0.0006	0.0010	0.153	
13	0.0031	0.0052	0.008	0.0133	0.210	
14	0.0004	0.0007	0.0005	0.0008	0.131	
15	0.0028	0.0047	0.0059	0.0098	0.150	
16	0.0004	0.0007	0.0006	0.0010	0.115	
17	0.0035	0.0058	0.0054	0.0090	0.132	

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18	0.0004	0.0007	0.0005	0.0008	0.102	
19	0.0045	0.0075	0.0071	0.0118	0.118	
20	0.0005	0.0008	0.0007	0.0012	0.092	
21	0.005	0.0083	0.0052	0.0087	0.107	0.160
22	0.0003	0.0005	0.0008	0.0013	0.084	
23	0.0062	0.0103	0.0035	0.0058	0.098	0.147
24	0.0004	0.0007	0.0007	0.0012	0.077	
25	0.0028	0.0047	0.0027	0.0045	0.090	0.135
26	0.0003	0.0005	0.0008	0.0013	0.071	
27	0.0021	0.0035	0.0019	0.0032	0.083	0.124
28	0.0003	0.0005	0.0007	0.0012	0.066	
29	0.0008	0.0013	0.0004	0.0007	0.078	0.117
30	0.0003	0.0005	0.0006	0.0010	0.061	
31	0.0006	0.0010	0.0007	0.0012	0.073	0.109
32	0.0004	0.0007	0.0008	0.0013	0.058	
33	0.0008	0.0013	0.0022	0.0037	0.068	0.102
34	0.0003	0.0005	0.0005	0.0008	0.054	
35	0.0015	0.0025	0.0033	0.0055	0.064	0.096
36	0.0003	0.0005	0.0006	0.0010	0.051	
37	0.0014	0.0023	0.0039	0.0065	0.061	0.091
38	0.0004	0.0007	0.0005	0.0008	0.048	
39	0.0027	0.0045	0.0039	0.0065	0.058	0.087
40	0.001	0.0017	0.0011	0.0018	0.046	

Note the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN 61000-3-2 in the box below.

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Power Quality – Voltage fluctuations and Flicker: These tests should be undertaken in accordance with EREC G98 Annex A1 A.1.3.3 (**Inverter** connected) or Annex A2 A.2.3.3 (Synchronous).

	Starting			Stopping			Running	
	d max	d c	d(t)	d max	d c	d(t)	P_{st}	P_{lt} 2 hours
Measured Values at test impedance	0.2	0.2	0	0.29	0.27	0	0.07	0.07
Normalised to standard impedance	0.56	0.56	0	0.8	0.75	0	0.19	0.19
Normalised to required maximum impedance	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Limits set under BS EN 61000-3-11	4%	3.3%	3.3%	4%	3.3%	3.3%	1.0	0.65

Test Impedance	R	0.24	Ω	X	0.15	Ω
Standard Impedance	R	0.24 * 0.4 ^	Ω	X	0.15 * 0.25 ^	Ω
Maximum Impedance	R	N/A	Ω	X	N/A	Ω

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* Applies to three phase and split single phase **Micro-generators**.

^ Applies to single phase **Micro-generators** and **Micro-generators** using two phases on a three phase system.

For voltage change and flicker measurements the following formula is to be used to convert the measured values to the normalised values where the power factor of the generation output is 0.98 or above.

Normalised value = Measured value*reference source resistance/measured source resistance at test point.

Single phase units reference source resistance is 0.4 Ω

Two phase units in a three phase system reference source resistance is 0.4 Ω.

Two phase units in a split phase system reference source resistance is 0.24 Ω.

Three phase units reference source resistance is 0.24 Ω.

Where the power factor of the output is under 0.98 then the X to R ratio of the test impedance should be close to that of the Standard Impedance.

The stopping test should be a trip from full load operation.

The duration of these tests need to conform to the particular requirements set out in the testing notes for the technology under test. Dates and location of the test need to be noted below

Test start date	22 July 2020	Test end date	22 July 2020
Test location	1 Treffers Rd, Wigram, Christchurch, NZ		

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Power quality – DC injection: This test should be carried out in accordance with EN 50438 Annex D.3.10				
Test power level	20%	50%	75%	100%
Recorded value in Amps	0.020 mA	0.041 mA	0.027 mA	0.053 mA
as % of rated AC current	0.0013 %	0.0027 %	0.0018 %	0.0035 %
Limit	0.25%	0.25%	0.25%	0.25%

Power Quality – Power factor: This test shall be carried out in accordance with EN 50538 Annex D.3.4.1 but with nominal voltage -6% and +10%. Voltage to be maintained within ±1.5% of the stated level during the test.			
	216.2 V	230 V	253 V
20% of **Registered Capacity**	0.98	0.98	0.97
50% of **Registered Capacity**	1.00	1.00	1.00
75% of **Registered Capacity**	1.00	1.00	1.00
100% of **Registered Capacity**	1.00	1.00	1.00
Limit	>0.95	>0.95	>0.95

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Protection – Frequency tests: These tests should be carried out in accordance with EN 50438 Annex D.2.4 and the notes in EREC G98 Annex A1 A.1.2.3 (**Inverter** connected) or Annex A2 A.2.2.3 (Synchronous)

Function	Setting		Trip test		"No trip tests"	
	Frequency	Time delay	Frequency	Time delay	Frequency /time	Confirm no trip
U/F stage 1	47.5 Hz	20 s	47.52 Hz	20.3 s	47.7 Hz 30 s	Confirmed
U/F stage 2	47 Hz	0.5 s	47.02 Hz	0.62 s	47.2 Hz 19.5 s	Confirmed
					46.8 Hz 0.45 s	Confirmed
O/F stage 1	52 Hz	0.5 s	51.98 Hz	0.63 s	51.8 Hz 120.0 s	Confirmed
					52.2 Hz 0.45 s	Confirmed

Note. For frequency trip tests the frequency required to trip is the setting ± 0.1 Hz. In order to measure the time delay a larger deviation than the minimum required to operate the projection can be used. The "No trip tests" need to be carried out at the setting ± 0.2 Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

Protection – Voltage tests: These tests should be carried out in accordance with EN 50438 Annex D.2.3 and the notes in EREC G98 Annex A1 A.1.2.2 (**Inverter** connected) or Annex A2 A.2.2.2 (Synchronous)

Function	Setting		Trip test		"No trip tests"	
	Voltage	Time delay	Voltage	Time delay	Voltage /time	Confirm no trip
U/V	184 V	2.5 s	183.1 V	2.58 s	188 V 5.0 s	Confirmed
					180 V 2.45 s	Confirmed
O/V stage 1	262.2 V	1.0 s	262.9 V	1.08 s	258.2 V 5.0 s	Confirmed
O/V stage 2	273.7 V	0.5 s	272.9 V	0.56 s	269.7 V 0.95 s	Confirmed
					277.7 V 0.45 s	Confirmed

Note for Voltage tests the Voltage required to trip is the setting ±3.45 V. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting ±4 V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

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Protection – Loss of Mains test: For PV **Inverters** shall be tested in accordance with BS EN 62116. Other **Inverters** should be tested in accordance with EN 50438 Annex D.2.5 at 10%, 55% and 100% of rated power.

~~To be carried out at three output power levels with a tolerance of plus or minus 5% in Test Power levels.~~

~~Test Power~~	~~10%~~	~~55%~~	~~100%~~	~~10%~~	~~55%~~	~~100%~~
~~Balancing load on islanded network~~	~~95% of **Registered Capacity**~~	~~95% of **Registered Capacity**~~	~~95% of **Registered Capacity**~~	~~105% of **Registered Capacity**~~	~~105% of **Registered Capacity**~~	~~105% of **Registered Capacity**~~
~~Trip time. Limit is 0.5 s~~						

~~For Multi phase **Micro-generators** confirm that the device shuts down correctly after the removal of a single fuse as well as operation of all phases.~~

~~Test Power~~	~~10%~~	~~55%~~	~~100%~~	~~10%~~	~~55%~~	~~100%~~
~~Balancing load on islanded network~~	~~95% of **Registered Capacity**~~	~~95% of **Registered Capacity**~~	~~95% of **Registered Capacity**~~	~~105% of **Registered Capacity**~~	~~105% of **Registered Capacity**~~	~~105% of **Registered Capacity**~~
~~Trip time. Ph1 fuse removed~~						
~~Test Power~~	~~10%~~	~~55%~~	~~100%~~	~~10%~~	~~55%~~	~~100%~~
~~Balancing load on islanded network~~	~~95% of **Registered Capacity**~~	~~95% of **Registered Capacity**~~	~~95% of **Registered Capacity**~~	~~105% of **Registered Capacity**~~	~~105% of **Registered Capacity**~~	~~105% of **Registered Capacity**~~
~~Trip time. Ph2 fuse removed~~						
~~Test Power~~	~~10%~~	~~55%~~	~~100%~~	~~10%~~	~~55%~~	~~100%~~
~~Balancing load on islanded network~~	~~95% of **Registered Capacity**~~	~~95% of **Registered Capacity**~~	~~95% of **Registered Capacity**~~	~~105% of **Registered Capacity**~~	~~105% of **Registered Capacity**~~	~~105% of **Registered Capacity**~~
~~Trip time. Ph3 fuse removed~~						

~~Note for technologies which have a substantial shut down time this can be added to the 0.5 s in establishing that the trip occurred in less than 0.5 s. Maximum shut down time could therefore be up to 1.0 s for these technologies.~~

~~Indicate additional shut down time included in above results.~~	~~ms~~

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Type Test Verification Report

For **Inverters** tested to BS EN 62116 the following sub set of tests should be recorded in the following table.

Test Power and imbalance	33% -5% Q Test 22	66% -5% Q Test 12	100% -5% P Test 5	33% +5% Q Test 31	66% +5% Q Test 21	100% +5% P Test 10
Trip time. Limit is 0.5 s	48 ms	43 ms	194 ms	72 ms	68 ms	134 ms

Protection – Frequency change, Vector Shift Stability test: This test should be carried out in accordance with EREC G98 Annex A1 A.1.2.6 (**Inverter** connected) or Annex A2 A.2.2.6 (Synchronous).

	Start Frequency	Change	Confirm no trip
Positive Vector Shift	49.0 Hz	+50 degrees	Confirmed
Negative Vector Shift	50.0 Hz	- 50 degrees	Confirmed

Protection – Frequency change, RoCoF Stability test: The requirement is specified in section 11.3, test procedure in Annex A.1.2.6 (**Inverter** connected) or Annex A2 A.2.2.6 (Synchronous).

Ramp range	Test frequency ramp:	Test Duration	Confirm no trip
49.0 Hz to 51.0 Hz	+0.95 Hzs^{-1}	2.1 s	Confirmed
51.0 Hz to 49.0 Hz	-0.95 Hzs^{-1}	2.1 s	Confirmed

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Type Test Verification Report

Limited Frequency Sensitive Mode – Overfrequency test: This test should be carried out in accordance with EN 50438 Annex D.3.3 Power response to over- frequency. The test should be carried out using the specific threshold frequency of 50.4 Hz and **Droop** of 10%.				
Test sequence at **Registered Capacity** >80%	Measured **Active Power** Output	Frequency	Primary Power Source	**Active Power** Gradient
Step a) 50.00 Hz ±0.01 Hz	350.1 W	50.00 Hz	DC Supply	-
Step b) 50.45 Hz ±0.05 Hz	347.5 W	50.45 Hz		-
Step c) 50.70 Hz ±0.10 Hz	330.3 W	50.70 Hz		-
Step d) 51.15 Hz ±0.05 Hz	299.3 W	51.15 Hz		-
Step e) 50.70 Hz ±0.10 Hz	330.4 W	50.70 Hz		-
Step f) 50.45 Hz ±0.05 Hz	347.5 W	50.45 Hz		-
Step g) 50.00 Hz ±0.01 Hz	350.5 W	50.00 Hz		10 %
Test sequence at **Registered Capacity** 40% - 60%	Measured **Active Power** Output	Frequency	Primary Power Source	**Active Power** Gradient
Step a) 50.00 Hz ±0.01 Hz	177.6 W	50.00 Hz	DC supply	-
Step b) 50.45 Hz ±0.05 Hz	176.4 W	50.45 Hz		-
Step c) 50.70 Hz ±0.10 Hz	167.5 W	50.70 Hz		-
Step d) 51.15 Hz ±0.05 Hz	151.6 W	51.15 Hz		-
Step e) 50.70 Hz ±0.10 Hz	167.5 W	50.70 Hz		-
Step f) 50.45 Hz ±0.05 Hz	176.4 W	50.45 Hz		-
Step g) 50.00 Hz ±0.01 Hz	177.8 W	50.00 Hz		9.9 %
Steps as defined in EN 50438				

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Type Test Verification Report

Power output with falling frequency test: This test should be carried out in accordance with EN 50438 Annex D.3.2 active power feed-in at under-frequency.			
Test sequence	Measured **Active Power** Output	Frequency	Primary power source
Test a) 50 Hz ± 0.01 Hz	349.2 W	50 Hz	DC supply
Test b) Point between 49.5 Hz and 49.6 Hz	349.2 W	49.55 Hz	DC supply
Test c) Point between 47.5 Hz and 47.6 Hz	349.0 W	47.55 Hz	DC supply
NOTE: The operating point in Test (b) and (c) shall be maintained for at least 5 minutes			

Re-connection timer.						
Test should prove that the reconnection sequence starts after a minimum delay of 20 s for restoration of voltage and frequency to within the stage 1 settings of Table 2.						
Time delay setting	Measured delay		Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 2.			
20 s	33 s		At 266.2 V	At 180.0 V	At 47.4 Hz	At 52.1 Hz
Confirmation that the **Micro-generator** does not re-connect.			Confirmed	Confirmed	Confirmed	Confirmed

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Type Test Verification Report

Fault level contribution: These tests shall be carried out in accordance with EREC G98 Annex A1 A.1.3.5 (**Inverter** connected) and Annex A2 A.2.3.4 (Synchronous).

For machines with electro-magnetic output			For **Inverter** output		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	i_p	7.38	20 ms	0	0
Initial Value of aperiodic current	A	4.21	100 ms	0	0
Initial symmetrical short-circuit current*	I_k	3.18	250 ms	0	0
Decaying (aperiodic) component of short circuit current*	i_{DC}	0	500 ms	0	0
Reactance/Resistance Ratio of source*	$^X/_R$	2.5	Time to trip	0.01	In seconds

For rotating machines and linear piston machines the test should produce a 0 s – 2 s plot of the short circuit current as seen at the **Micro-generator** terminals.

* Values for these parameters should be provided where the short circuit duration is sufficiently long to enable interpolation of the plot

Logic Interface.	Yes
Self-Monitoring solid state switching: No specified test requirements. Refer to EREC G98 Annex A1 A.1.3.6 (**Inverter** connected).	Yes
It has been verified that in the event of the solid state switching device failing to disconnect the **Micro-generator**, the voltage on the output side of the switching device is reduced to a value below 50 V within 0.5 s.	

Additional comments

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Test Equipment calibration

List of measurement units used for investigation

Description	Manufacturer	Model Number	Last Cal date	Next Due Date	Cal Control
Current Probe Amplifier	Tektronix	TCPA300	2019-08-12	2020-08-11	SAF-CPA-01
Current Probe Amplifier	Tektronix	TCPA300	2019-08-09	2020-08-08	SAF-CPA-02
Current Probe Power Supply	Keysight	N2779A	NCR	NCR	SAF-CPA-04
Current Probe Power Supply	Keysight	N2779A	NCR	NCR	SAF-CPA-04
DATA AQUISITION / SWITCH UNIT	Keysight	34970A	2020-03-11	2021-03-11	SAF-DAT-02
Differential Probe	Keysight	N2790A	2019-08-09	2020-08-08	SAF-DFP-01
Differential Probe	Keysight	N2790A	2020-03-06	2021-03-06	SAF-DFP-05
Digital Multimeter	Keysight	34461A	2020-03-05	2021-03-05	SAF-DMM-02
Demand Response Enabling Device (AS4777.2-2015 Appendix I)			NCR	NCR	SAF-DRD-01
Current Probe	Keysight	1147B	2020-02-21	2021-02-20	SAF-KCP-02
Current Probe	Keysight	1147B	2020-02-21	2021-02-20	SAF-KCP-05
20 CH MULTIPLEXER CARD (with SAF-DAT-01)	Keysight	34901A	2020-03-11	2021-03-11	SAF-MUX-01
20 CH MULTIPLEXER CARD (with SAF-DAT-01)	Keysight	34901A	2020-03-11	2021-03-11	SAF-MUX-02
Oscilloscope	Tektronix	TDS3034C	2020-03-17	2021-03-17	SAF-OSC-02
Oscilloscope	Agilent	MSO-X 3034A	2019-08-09	2020-08-08	SAF-OSC-04
Oscilloscope	Keysight	DSO-X 3034T	2020-03-05	2021-03-05	SAF-OSC-05
Power Quality Analyzer	Yokogawa	WT1800	2020-05-29	2021-05-29	SAF-PQA-02
Power Quality Analyzer	Yokogawa	WT3000E	2020-02-20	2021-02-19	SAF-PQA-06
AC POWER SOURCE	California Instruments	MX30	NCR	NCR	SAF-PSU-02
RLC Load for Anti-Islanding	QUNLING	ACLT-3802H	2020-05-19	2021-05-19	SAF-RLC-01
Modular SAS Mainframe	Keysight	E4360A	NCR	NCR	SAF-SAS-01
Solar Array Simulator (in SAF-SAS-01)	Keysight	E4361A	NCR	NCR	SAF-SAS-02
Solar Array Simulator (in SAF-SAS-01)	Keysight	E4361A	NCR	NCR	SAF-SAS-03
Modular SAS Mainframe	Keysight	E4360A	NCR	NCR	SAF-SAS-04
Solar Array Simulator (in SAF-SAS-04)	Keysight	E4361A	NCR	NCR	SAF-SAS-05
Solar Array Simulator (in SAF-SAS-04)	Keysight	E4361A	NCR	NCR	SAF-SAS-06
Modular SAS Mainframe	Keysight	E4360A	NCR	NCR	SAF-SAS-07
Solar Array Simulator (in SAF-SAS-07)	Keysight	E4361A	NCR	NCR	SAF-SAS-08
Solar Array Simulator (in SAF-SAS-07)	Keysight	E4361A	NCR	NCR	SAF-SAS-09
Modular SAS Mainframe	Keysight	E4360A	NCR	NCR	SAF-SAS-22
Solar Array Simulator (in SAF-SAS-22)	Keysight	E4361A	NCR	NCR	SAF-SAS-23
Solar Array Simulator (in SAF-SAS-22)	Keysight	E4361A	NCR	NCR	SAF-SAS-24
Short Circuit Test box			NCR	NCR	SAF-SCT-01
Current Probe	Tektronix	TCP303	2019-08-12	2020-08-11	SAF-TCP-01
Current Probe	Tektronix	TCP303	2019-08-09	2020-08-08	SAF-TCP-02
Current Probe	Keysight	N2783B	2019-08-09	2020-08-08	SAF-TCP-05
Current Probe	Agilent Technologies	1147A	2019-08-12	2020-08-11	SAF-TCP-07
Current Probe	Agilent Technologies	1147A	2019-08-09	2020-08-08	SAF-TCP-08
Power Quality Analyzer	Yokogawa	WT3000	2019-08-13	2020-08-12	SAF-PQA-08
AC POWER SOURCE	Pacific Power Source	305AMXT-UPC32E	NCR	NCR	SAF-PSU-05

NCR: No Calibration Required

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Photographic Record of Test Sample

Photographic Record of Sample

IQ7A Photos:

Figure 2: IQ7A general view

Figure 3: IQ7A bottom

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Photographic Record of Test Sample

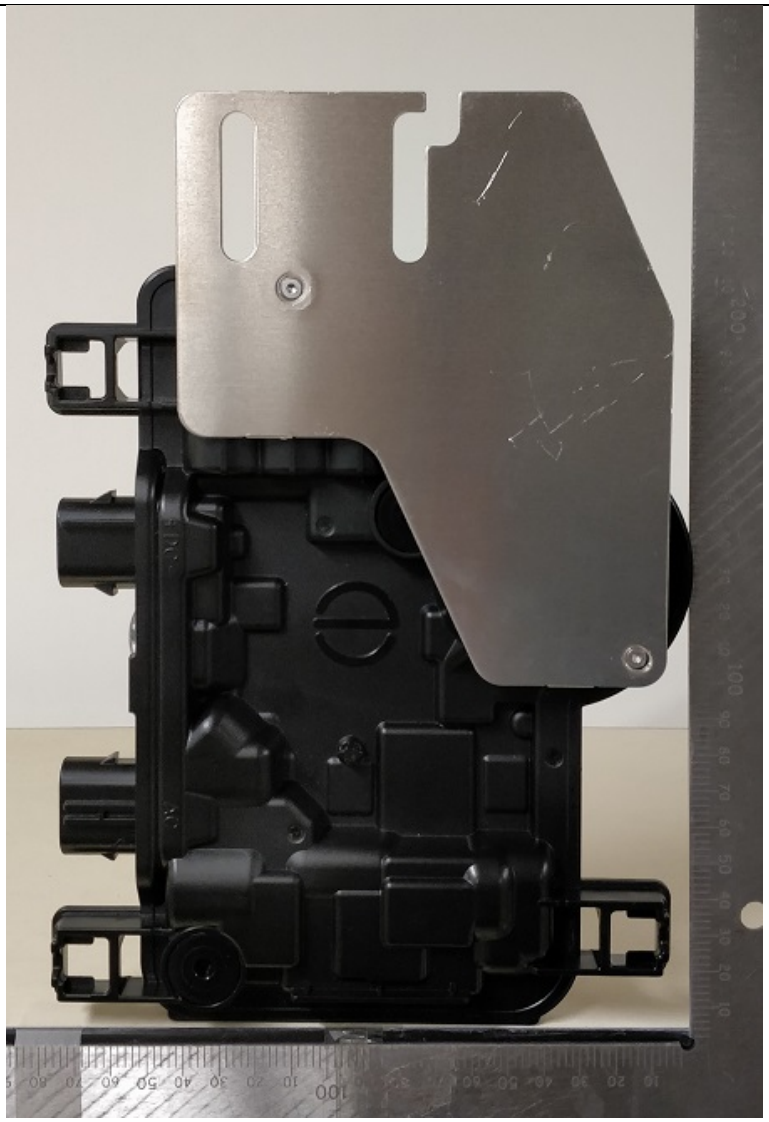

Figure 4: IQ7A top

Figure 5: IQ7A connector side

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Photographic Record of Test Sample

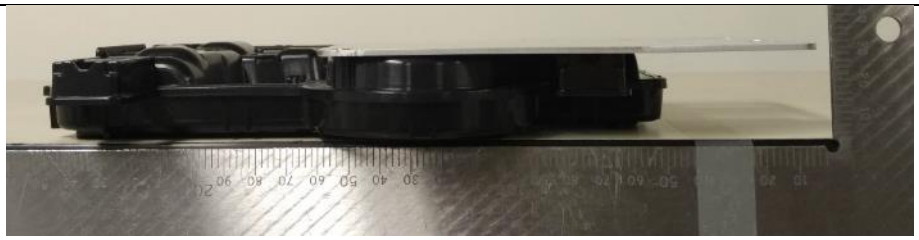

Figure 6: IQ7A right side

Figure 7: IQ7A label side

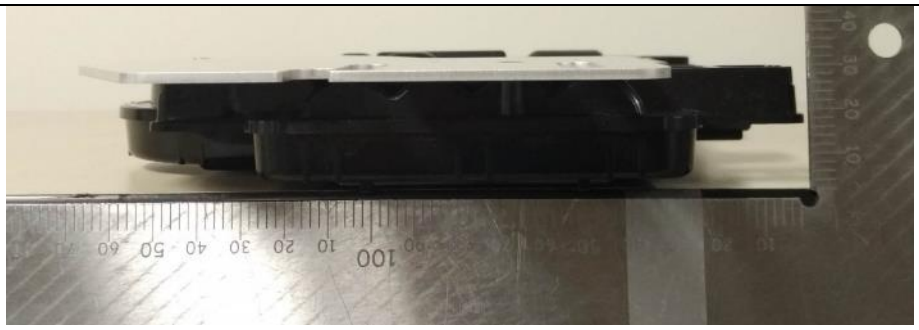

Figure 8: IQ7A mounting plate side

End of report